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SAFETY METHODS IN THE CARE OF SURGICAL PATIENTS.

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The writer has been led to prepare this paper by the receipt of the following letter addressed to him by a surgeon well known in Europe as well as in the United States:

———— November 20, 1916.

My dear Doctor Kellogg:

For about five years I have been operating at ————. I have been struck by the uniformly favorable reaction in operative procedures under the hydrotherapeutic treatment that they apply before, during, and immediately after the anesthetic. I have understood that it is a treatment following the lines of procedure established at your institution. Have you anything in pamphlet form, or anything to which you could refer me, that explains scientifically why those patients uniformly promptly recover their circulation, are quickly restored to normal, the pain caused by gas in ordinary cases eliminated, and almost invariable recovery without apparent shock or ether-pneumonias?

Yours very truly,

Many other surgeons visiting the Battle Creek Sanitarium Hospital having shown a like interest in the methods followed in our surgical wards, I thought it might be worth while to present in this form a somewhat detailed account of them. I do not claim, by any means, that all are new or original, although the writer believes himself to have been a pioneer in the adaptation of hydriatic methods to the care of surgical cases, and in many features of the pre-operative and post-operative feeding of such cases, especially with reference to acidosis and intestinal asepsis.

Most of the special procedures which I and my colleagues employ in the care of our surgical cases have been in use by us for many years. The chief of them were put in operation nearly thirty years ago and were described in a paper published in 1895.* New features have been added from time to time as the result of experience and observation of the work of others, suggestions of assistants, of intelligent nurses and, sometimes, suggestions made by patients themselves.

I am especially indebted to my surgical colleague, Dr. James T. Case and our hospital physician, Dr. Bertha Moshier, for many valuable hints, and especially for the systematic carrying out of measures found to be valuable.

* Intestinal Asepsis and Antisepsis in Abdominal Surgery.

In the following description of these methods, special emphasis has been laid upon points in which there is an essential departure from routine methods that are universally employed, references to which are, for the most part omitted, to economize space.

PREPARATION OF THE PATIENT.

In emergency cases, the preliminary preparation is of necessity brief, and sometimes will consist of nothing more than the application of the necessary means to avoid sepsis. But when haste is not necessarily involved, much can be done to lessen the risk of complications and to improve the results of operations, by a period of special preparation which may profitably occupy from 24 to 48 hours in nearly all cases, and in abdominal cases a week. In special cases, several weeks may be most profitably employed in getting ready for the ordeal of a severe operation, especially in improving the patient's metabolism and changing the intestinal flora. Patients who come to the operating table with badly coated tongue, foul breath and other symptoms of intestinal toxemia, are much more likely to suffer from shock, collapse, renal failure, pronounced acidosis, anemia, peritonitis and other complications, and make slower recoveries than those who come with a clean tongue and a sweet breath.

First of all, the patient is subjected to a thoroughgoing physical examination, after a careful clinical history of the case has been taken. This includes, in addition to routine methods, the following: A fluoroscopic examination of the chest; a blood count, estimation of hemoglobin, and differential count of leucocytes; a chemical examination of the blood for non-protein nitrogen, uric acid and sugar; a Wassermann test and, if indicated, other serological tests; examination of the heart and bloodvessels and determination of the systolic and diastolic blood pressure; a bacteriological examination of the blood; a quantitative examination of the urine, including a determination of the total nitrogen and of the ammonia content, of indican and other conjugate sulphates, and of the acidity by the hydrogen-ionic method; determination of the urinary efficiency by the phenolphthalein test, or better, the urinary test ration; determination of the CO_2 tension of the residual air with reference to acidosis; careful examination of the nose, throat, mouth and teeth, with reference to focal infection; investigation of vaginal and other secretions, with reference to possible focal infection; a determination of the motility of the alimentary canal by means of the charcoal or carmine test, and, in case of abdominal operations, a barium meal and x-ray examination of the entire alimentary canal.

An electrocardiographic tracing is made together with a careful study of the heart in relation to myo-

carditis or other grave organic changes whenever there is reason to suspect the presence of these conditions. A determination of the heart efficiency and of the vascular tone is also made by means of exercise and posture tests.

A patient with low pressure needs to have a reenforcement of heart energy and an increase of blood volume before going upon the operating table. This may be secured in most cases by proper feeding and by graduated cold baths administered twice daily, beginning with cold mitten frictions or towel rubs, increasing the vigor of the applications from day to day, as reaction improves. Copious water drinking, the fresh air cure and the milk regimen, massage and automatic exercise are other useful measures.

High blood pressure may be lowered by rest in bed, low protein diet and withdrawal of all pressure-raising toxins, as tea, coffee, tobacco, alcohol, and condiments of all sorts and by changing the intestinal flora.

Rest in bed and automatic exercise of the muscles applied daily are also highly effectual measures for lowering blood pressure. Improvement is often shown by a lowering of the diastolic pressure, even when the systolic pressure remains the same. This increases the pulse pressure and the blood movement and so lessens the load upon the heart and prepares it for the strain of the operation.

Careful note is made of the patient's physique. The chest capacity is determined not only by the spirometer and the tape line but by the dynamometer. The total strength of the patient, as well as of each individual group of muscles, may be determined by the aid of the "universal dynamometer."

Highly important information is obtained by the determination of the patient's metabolism by the aid of the Tissot, Benedict, or some similar respiration apparatus adapted to clinical work.

A thorough knowledge of the patient's condition obtained by such an examination as the foregoing renders possible a just estimate of his ability to withstand the ordeal of an operation and of the possible complications to be guarded against.

Such an examination also affords an opportunity to greatly enhance the patient's chances for recovery and for a successful operation, by correcting any existing defects that may be observed.

The deaths that occur in cases confidently expected to recover are often due to causes that might have been discovered by a careful examination of the sort above outlined, and might have been avoided by the special precautions which such an examination would have suggested.

Measures that greatly add to the safety of severe operations and contribute to the comfort of the patient naturally fall into three groups, 1. Those that precede the operation; 2. Those that are applied during the operation; and 3. Those that follow the operation.

MEANS THAT INCREASE GENERAL VITAL RESISTANCE.

Many years ago Benjamin Ward Richardson suggested that many deaths following operation are due to the fact that the patient belongs to a class of persons whom he termed the *morituri*, that is, persons who because of general low vital resistance or some special weakness are ready to succumb to any severe strain upon their vital resources. Unquestionably, the ability to survive a severe surgical operation differs in different persons and in the same person at different times. Hence, it is reasonable to believe that all measures by which the patient's resistance may be improved are of importance as means of prepration for the ordeal.

The value of certain hydriatic measures as means of increasing vital resistance has long been known Currie, more than a hundred and twenty years ago called attention to the stimulating effect of cold baths, and sagaciously remarked that "It is not the cold which stimulates, but the sensation which the cold produces." That is, the stimulating effect of cold is produced by the reflex effects set up through impressions made upon the thermic nerves. This is the rationale of the general stimulating effect of short, cold frictions, especially the mitten friction and the towel rub. Such applications are followed by a reaction in which the activity of the bloodvessels of the skin are enormously increased.

Through reflex action, these applications of cold to the skin are accompanied by similar effects upon the circulation of the viscera. After a general short, cold application, the heart acts with greater vigor and the movement of the blood throughout the viscera and all other internal parts is greatly accelerated.

These short, cold applications have a powerful tonic effect upon the heart. Cold applications also quicken and deepen the respiratory movements. The chest is more fully expanded than usual. Residual air is driven out and the volume of the tidal air increased. The beneficial effect upon the nervous system is shown in the marked increase in muscular tone following a tonic application of cold water such as a towel rub, a mitten friction, a sheet rub or a cold douche. After such an application, there is a general feeling of well-being and increased vigor. It is this fact which renders the cold morning bath so favorite a measure with those who are acquainted with its benefits.

Under the influence of these cold applications, the "tonus" of the stomach is increased, secretion and excretion are increased, appetite and digestion are improved, the blood is better circulated and the whole body flourishes.

The influence upon the blood of short, cold baths, especially when preceded by a warm bath, was shown many years ago by Winternitz, who demonstrated an increase in the red blood cells amounting to fully one-third, after a short, cold bath preceded by a warm bath.

The increase of white cells was still greater, amounting to 300 per cent. This increase occurs within a half hour after the application of the bath, showing that it is not due to the production of new cells but to the return to the general circulation of blood cells held back in the congested liver, spleen and other viscera.

The importance of such an increase of leucocytes

in the circulating blood of the surgical patient cannot be overestimated since it is upon these cellular elements that the body chiefly depends to repair injuries and to combat invading microörganisms.

Henocque and Crawford have shown that under the influence of tonic cold baths, the oxygen-carrying capacity of the blood is greatly increased, and d'Arsonval, with others, has shown that as the result of such applications, the amount of oxygen passed through the body in a given time, is notably increased.

By these means it becomes an easy matter to increase the amount of oxygen supplied to the tissues and without the inhalation of oxygen gas, a method by no means always available. In fact, ordinary air always contains more oxygen than the blood is able to take up, and the advantages derived from the inhalation of pure oxygen are small compared with the aid afforded by an improvement in the absorption and utilization of oxygen.

Cold friction may be applied several times a day and may always be depended upon to increase the oxygen-carrying power of the blood and is a remedy which is always instantly available.

Strasser demonstrated more than twenty years ago that general cold applications increased the alkalinity of the blood, one of the most efficient means by which general vital resistance may be augmented, and the danger of surgical acidosis combated.

Strasser and others have shown the influence of the cold bath in stimulating the general metabolic changes throughout the body, thus promoting repair and hastening convalescence.

Strasser also showed that the improved condition secured through the cold applications reduces the imperfectly oxidized wastes of the body from 8.7 per cent of the total amount excreted to 1.7 per cent, an improvement of more than 500 per cent.

The increased CO_2 elimination following cold applications is substantial evidence of increased oxidization and accelerated metabolism. The change produced in the average invalid by tonic applications of cold water, preceded by short warm applications, such as an electric light bath or some other thermic application, is often very striking, and it is even more evident to the patient himself than to the physician, in increased vigor, endurance and a sense of well-being.

The writer has for many years followed the plan of giving to his surgical patients at least one week of this tonic treatment when possible to do so, and a second or even a third week of treatment may often be given to excellent advantage when no urgency exists.

Before operation the surgical patient should spend every moment possible in the open air, both night and day. The good results of the "fresh air cure" are clearly established by the experience of hundreds of sanatoria for consumptives in which it is the principal therapeutic measure employed, aside from the regulation of the diet.

A countryside hospital well supplied with pure air affords the best opportunity for first-class results. My own operating-room is closed to external air, all the air admitted being purified by thorough washing with a suitable apparatus. Smooth glass walls and porcelain tiled floor are additional measures of safety.

PREPARATORY REGIMEN.

While receiving the benefit of these tonic measures, the patient's diet is carefully looked after. A well trained dietitian prepares the menu for every meal and takes care to see that the daily ration is *carefully* balanced, not only in relation to protein, fats, and carbohydrates, but in relation to food iron, food lime and other organic salts and vitamins.

If the patient's blood is low in hemoglobin, and especially if there is likely to be more or less loss of blood in the prospective operation, effort is made to build the blood up as much as possible by the free use of greens, which are taken in liberal doses at every meal, distaste being prevented by serving a variety of different greens instead of confining the patient to a single kind. Turnip tops, witloof, beet tops, lamb's quarter, red root, narrow-leaved dock and purslane are readily available during the summer, and at other seasons, by the aid of hot houses, a necessary accessory of all large institutions for the care of the sick. Spinach is always obtainable. In extreme cases, transfusion from a suitably selected donor is resorted to.

Changing the Intestinal Flora.—One of the most important things to be done in the preparation of a patient for a severe surgical procedure is to change his intestinal flora. Many years ago, Bouchard called attention to the enormous injury done to the body by the toxins produced through putrefaction of the food residues in the colon. He showed that a carefully filtered infusion of the human feces injected into the veins of a rabbit will produce death in a few minutes. A little later Vital and Roux called attention to the readiness with which the colon bacillus finds entrance into the circulation from the colon and, infecting the tissues, may set up pleurisy, peritonitis, hepatic abscess and other complications which not infrequently occur after severe operations.

Mr. Lawson Tait of Birmingham, England, was one of the first to recognize the relation between colon contents and peritonitis and to make a practical application of the doctrine of Bouchard to abdominal surgery. He recognized the fact that bacteria readily find their way from the intestinal tract to the peritoneal cavity, and to prevent this took great care to thoroughly empty the intestine before operation, and to secure thorough and early evacuation of the bowels after operation.

Acting as a pupil assistant for a few months some thirty years ago (1889) I asked Tait one day what he considered the most efficient means of combating peritonitis following a laparotomy. He instantly replied, in his characteristic manner, "Nothing at all; the patient who has peritonitis after a surgical operation is certain to die. The time to cure peritonitis is before it begins. If the peritoneal cavity is kept well drained, peritonitis will not occur. The important thing is to purge the patient to keep the peritoneal cavity free from stagnant

fluids. I am not afraid of germs, they cannot grow without food."

Tait purged the patient vigorously both before and after the operation, and, although he did not wear rubber gloves and was by no means scrupulously cleanly in his methods, he was able to show a record of 116 laparotomies in succession without a single death.

After returning home, within six years, I made several series of abdominal sections, aggregating 440 cases in all, in which by the addition of many of the measures detailed in this paper to the special technic learned from Tait, I was able to secure a great reduction in the mortality rate current in this country at that time. Of these, were a series of 87 cases of ovarian and broad ligament tumors, with one death; 233 cases of non-septic, ovarian cysts, with one death; a series of 165 successive cases of removal of ovarian tumors, diseased ovaries or appendages, without a single death.

The possibility of changing the flora demonstrated by Tissier and Metchnikoff was later brought forward. Although the buttermilk method of Metchnikoff proved to be inefficient and unreliable, the fundamental idea was a good one, and after many unsuccessful efforts, I finally succeeded in developing a simple plan for changing the intestinal flora which has proved itself to be effective and satisfactory in all cases except those in which serious mechanical obstruction of the intestine exists. This plan is simply the employment of a fruit regimen for a few days. This consists of fresh fruit combined with bran or agar, with the addition of milk sugar (nine or ten ounces) and paraffin oil. When the hemoglobin is low, purees of greens are added.

The fruit regimen is especially indicated when the tongue is coated, the breath offensive and stools putrid; in other words, when the patient is toxic. After three or four days of this regimen, the tongue clears and the stools lose their putrid character. They become nearly odorless, or slightly sour in odor. Agar or bran and mineral oil are used in sufficient quantity to induce the bowels to move three or four times a day. If necessary, an enema of three or four pints of warm or tepid water is used twice a day. The colon must be made clean and kept clean. The change of flora is greatly facilitated by adding to the daily enema a few ounces of milk sugar or malt sugar and introducing into the colon after the enema, half a pint of an active whey culture of *b. bulgaricus and b. acidophilus.*

The advantage of getting rid of the load of toxins which the average patient carries is enormous. The intestinal stasis which usually follows a surgical operation, especially in abdominal cases, is sufficient in itself to tax the poison-destroying and eliminating functions of the body to the safety limit, and if this condition supervenes upon an already existing toxemia due to chronic colonic stasis, the dangers incident to operation are enormously increased.

Prophylaxis Against Shock.—For some years evidence has been accumulating that shock is due to an undue accumulation of toxins in the blood and tissues. Twenty-five years ago Lauder Brunton suggested that deaths under anesthesia are not directly due to the anesthetic but to the body toxins His theory was that the anesthetic served only to lessen the resistance of the living cells to the circulating toxins and to cripple the toxin-destroying power of the liver. Cannon and others have recently shown that shock may be the result of absorption from the injured surfaces of substances which produce a profoundly toxic effect upon the nerve centers and the terminal arteries.

It is evident that the freer from toxins the body can be made when an anesthetic is to be given, or a severe operation to be performed, the better the prospect for a safe and successful outcome.

After the flora has been changed by a few days of fruit regimen, a non-toxic dietary should be adhered to before the operation, after the operation, and until convalescence is fully established. This requires a reduction of the protein to as low a level as safety will permit, certainly not exceeding 10 per cent of the total calory value of the ration.

Bouillon and meat extracts of all sorts must be discarded. Sapelier, an eminent French surgeon, asserted many years ago that "Bouillon is a veritable solution of toxins." Meats must necessarily be discarded because of the readiness with which the undigested residues undergo putrefaction in the colon, besides introducing myriads of putrefactive bacteria which are always present in fresh, salted and smoked meats of all kinds.

The famous surgeon, Paget, in his lessons on surgery, many years ago asserted that "The high death rate from operations in cities, as compared with rural districts, is due to the fact that city dwellers eat large quantities of meat, while country dwellers in Europe taste meat only on occasions."

More than a dozen years ago Tissier called attention to the fact that vegetable proteins are only about "half as prone to putrefy as animal proteins," and Torrey has recently demonstrated the same fact. Neither bouillon nor meat broths are ever served to my surgical patients. Tea and coffee as well as wines are also scrupulously excluded from the bill of fare. Dr. Wiley has shown by analysis of coffee as served that a cup of cheap restaurant coffee contains two grains of caffein to the cup, and the coffee served at a first-class hotel twice as much. If caffein is needed, it is administered hypodermatically.

Storing up Glycogen.—It is most desirable that that wonderful poison-destroying organ, the liver, and the poison-eliminating kidneys should be gotten into as fine a condition as possible before the operation, so as to be prepared to deal with the anesthetic, itself an active poison, as well as the great influx of poisons naturally following the operation. For accomplishing this, it is especially important that the patient's diet should be rich in carbohydrates so that the patient's liver, muscles and body cells may be well stocked with glycogen. The detoxicating and poison-destroying functions of the liver have long been known to be associated with its glycogenic function. An ample store of glycogen is necessary to enable the liver to deal successfully with the toxins brought to it through the blood.

To insure that the liver cells shall be well filled

with glycogen at the time of the operation, the patient should take at least sixteen ounces of carbohydrates daily, and during two or three days before the operation it is well to administer eight or ten ounces of malt or milk sugar daily in addition to the regular meals, and four to six ounces of malt sugar well diluted with water should be given to the patient the morning of the operation in divided doses.

It is current practice in abdominal cases to give the patient no food on the day of operation. This plan has the disadvantage that it brings the patient to the operating table fasting and necessarily with his store of precious glycogen greatly reduced. Glycogen is necessary not only to support the heart in its activity, but to aid the liver in dealing with the great flood of toxins thrown into the blood by the anesthetic and the traumatism of the operation and which are the principal cause of shock, as shown by Cannon. An abundant store of glycogen in the liver and the body cells is the best possible means of protection against shock. In order to enrich the patient's store of glycogen, I have for years adopted the practice of giving the patient eight or ten ounces of malt sugar between the last meal at night before the operation and the hour of the operation. Four to six ounces of malt sugar dissolved in water may be given in divided doses the morning of the day of the operation.

The value of this ready-to-use nutriment is very great not only as a means of replenishing the liver's store of glycogen, but to sustain the heart which consumes a fraction of a calory of sugar at every beat, and especially to combat the acidosis invariably produced by the anesthetic.

Renal Efficiency.—If a high non-protein nitrogen content is shown by the blood test, or the urinary test ration shows renal inefficiency, the operative hazard may be enormously lessened by a few weeks' careful treatment, with an atoxic diet, changing the flora and improving metabolism and elimination.

Prophylaxis against Acidosis.—If the CO_2 tension is found to be less than 34, which is not infrequently the case in persons whose nutrition has been seriously interfered with by fever, low diet or other cause, the body's store of glycogen must be replenished and CO_2 tension raised to normal by carbohydrate feeding, particularly by the use of malt sugar and milk sugar, of which an ounce may be given in a half glass of water every hour, for a day or two before the operation, or even every half hour if the patient is able to retain fluids. If not, retaining enemas of malt or milk sugar, two ounces to the pint, are given. In extreme cases, intravenous injections of Ringer's solution with the addition of five per cent. of glucose are given.

Mouth Toilet.—Very special attention is given to the toilet of the mouth. The teeth are thoroughly cleansed by a dentist some days before the operation, and are daily polished by the patient or the nurse in attendance, with wood pulp or cloth paper, orange stick and points.

Focal Infections.—Special care is taken to discover and eradicate focal infections in teeth, tonsils, cervix uteri, or elsewhere.

The Colon.—In all cases, but especially in cases in which the abdomen is to opened, particular attention is given to the colon. It is rare to meet a chronic invalid or a surgical case that is not suffering from intestinal stasis. The fact that the bowels move once a day or even more than once a day, is no evidence that the colon is being promptly emptied of food residues and body wastes. X-ray examinations of the colon with the barium meal show that the average colon which is evacuated once a day does not dismiss the last remnant of the opaque meal in less than fifty to fifty-four hours, and a much longer time is often required. This means that the average colon contains constantly the residues of six or seven meals, and is from one to two days behind-hand in the dismissal of its contents. The contents of such a colon are always in an advanced stage of putrefaction, and in consequence, the bacterial flora is not only highly prolific and luxuriant, but very virulent.

Infection of the mucosa is usually shown to be present by the appearance of more or less mucus in the stools. By a few days' proper regimen and treatment, the condition of the colon may be completely changed.

At the outset the motility of the intestines should be determined. This may be done by giving the patient a couple of carmine capsules at breakfast and then noting the time of the appearance of the red color in the stools. The time of disappearance is also noted. The color should appear in ten to fourteen hours and disappear, at the longest, within twenty-six hours. If the motility test and examination of the stools or the *x*-ray examination of the intestinal canal show evidence of stasis or colitis a special course of treatment should be undertaken to get the colon into as healthy a condition as possible before an operation is undertaken. It is most desirable that the patient should have a clean tongue and a sweet breath and non-putrid stools before he lies down upon the operating table.

The fruit regimen for a few days will render the food residues non-putrefactive, and by the use twice daily of cleansing enemata and the introduction into the colon of active cultures of the *bacillus acidophilus* and *b. bifidus* in starch and milk sugar or dextrine solutions, the virulent putrefactive character of the flora will be rapidly changed and in many cases all evidence of colonic infection will disappear.

Improving the Intestinal Motility.—If two carmine capsules are taken at breakfast, an enema taken at bedtime should remove the last trace of red color. At the longest, the carmine should disappear after breakfast the next morning. A sufficient amount of mineral oil and agar or bran should be given to bring about this result. Before operation, the bowels should be made to move, if possible, three times a day, and without the use of laxatives. When this is accomplished, no difficulty will be found in moving the bowels after the operation.

It is important to know the motility time before the operation so as to know when to expect spontaneous movement after the operation.

Preparation of the Bowels.—The preparation of the bowels immediately before the operation is a matter of great importance. Tait's method of purging with saline laxatives before the operation was without doubt the means of saving many lives, but it involved serious inconveniences. Some years ago, Case called attention to the fact that after the administration of laxatives of any sort, the descending colon and often the entire colon is universally found in a highly spastic state. Alvarez has also called attention to the same fact. This condition of the descending colon after the administration of a laxative doubtless accounts, in large part at least, for the great difficulty often encountered in efforts to evacuate the colon after abdominal operations. Tait resorted to the most drastic measures. One of his favorite methods was to administer a tablespoonful of turpentine in a soap enema. These enemas were often many times repeated at intervals of two or three hours and sometimes until the patient was greatly exhausted.

Several years ago, Alvarez and Taylor of the University of California conducted experiments upon rabbits which proved the injurious effects of purgatives and the inadvisability of making use of purgative drugs in preparing a patient for an abdominal operation. These investigators thus described the effects of purgatives as studied in the intestines of rabbits, portions of which were removed and placed in a warm, saline solution, for the purpose of observing the automatic movements of the gut:

"The well purged rabbit is likely to be apathetic and to look sick. Its bowel is full of gas and fluid, and the mesenteric circulation is disturbed. Excised segments beat poorly and irregularly in Locke's solution, and they fatigue quickly. They respond poorly to drugs. Some parts of the bowel are abnormally irritable, while others fail to respond at all to powerful stimuli. This unevenness in the gradient of muscular forces must interfere with the steady progress of food through the gut; and it probably favors the production of colic and gas pains."

The investigators conclude on the basis of their experimentation with animals that it is not wise to purge shortly before an operation in which the bowel must stand drying, handling, cutting, and sewing. The surgeon may well give some heed to this suggestion, at any rate to the extent of carefully weighing the reputed advantages of preoperative purgation against the detriment suggested by these studies.

Castor oil and magnesium sulphate were found by these observers to produce a particularly bad effect upon the intestine.

Gosset and Mestrezat recently reported to the French Society of Biology (*La Presse Médicale*) the results of experiments in which they "studied the effects of purgation with castor oil on the urinary secretion and its possible relation to operative shock. They found that castor oil purgation provokes (1) a pronounced oliguria due to the purgation itself, which, with the restricted diet preparatory to operation, causes a reduction of from 29 to 70 per cent of the total volume of urine (an average of 37 per cent); (2) a notable diminution of the excreted materials (acids, extracts, ash, etc.); (3) an alteration of the composition of the urinary nitrogen, characterized by a diminution of the figure for urea nitrogen with an increase of the non-protein nitrogen. The non-protein nitrogen of the urine of 24 hours presents sometimes, even in spite of oliguria, a figure higher in absolute value than that of the normal urine.

"It is apparent from these facts that the efficiency of the kidney is lessened at a moment when the organism is subjected to the influence of chloroform or ether. It is also to be noted that there occurs during the days following purgation an altogether abnormal increase of the lesser known nitrogenous products which are recognized as a positive factor in shock."

I believe that the use of laxative drugs is highly detrimental. They should be carefully avoided in the preparation of the patient for the operating table, a practice which I have followed for some years, with most satisfactory results.

Case and other *x*-ray experts have shown that the food residues reach the colon on an average within eight hours after the meal is taken, the small intestine being at this time entirely empty. It is evident, then, that cathartics are not necessary for the evacuation of the colon and that they actually hinder the complete evacuation of the colon by causing a spastic contraction of the descending and pelvic colon. A warm enema, followed, if necessary, by a tepid enema, will suffice to empty the colon when mechanical obstruction does not exist. If a plain enema fails to secure complete evacuation of the colon, a half pint of malt extract or molasses or the juice of a lemon or a dram of citric acid may be added to the enema.

Gas in Small Intestine Due to Incompetency of the Ileocecal Valve.—The abdominal surgeon often experiences great inconvenience from the enormous amount of gas found present in the small intestines. Case demonstrated in human beings the retroperistaltic action of the colon, first observed by Cannon in cats, and in 1913 called attention to the fact that after a laxative of any kind the antiperistaltic action of the colon is very greatly exaggerated. This fact explains the presence of gas in the small intestine. The antiperistaltic action of the colon evidently forces the gas back from the colon through an incompetent ileocecal valve into the small intestine, thus preventing the intestine from emptying itself and causing retention in the intestine of semi-liquid feces with gas, and the absorption of toxins.

These difficulties are less likely to appear when laxative drugs are not used in preparing the patient for operation for the reason that laxative drugs of every sort cause spastic contraction of the descending colon and greatly exaggerate antiperistalsis. Since abandoning the use of laxatives before operation some years ago I have found in several hundred cases of abdominal section intestinal gas a serious inconvenience in only a few cases.

The only laxative measures employed in prepa-

ration for any operation are paraffin oil and the enema. Double doses of paraffin oil emulsion, an ounce before and after each meal, are given to the patient for two days before the operation. An extra dose is given at bedtime the night before the day of operation.

Paraffin oil empties the colon without producing spastic contraction, and leaves no irritation behind. It acts simply as a lubricant and may well replace castor oil and the saline laxatives of various sorts so commonly employed.

In addition to paraffin oil an enema is administered twice daily and on the morning of the operation. When this measure is employed efficiently, the colon is completely emptied, and the patient goes to the operating table with the intestines in the best possible condition.

WATER STORAGE IN THE TISSUES.

During the days immediately preceding the operation, the patient is required to drink from three to five pints of water daily in addition to the amount taken at meals. This has the effect to clear the body of toxins and to saturate the tissues with water, and increase the blood volume, thus preparing the body to deal with the flood of toxins with which it is deluged by the anesthetic and the unavoidable traumatism necessarily involved besides the intestinal stasis which often follows abdominal section.

Care of the Patient during Operation.—As Crile has so ably shown, the patient's mental state before the operation is a matter of much importance. It is my custom always to see the patient for a moment before the operation to say words of encouragement and, if possible, to send the patient into the operating room with a smile.

In former days, infection was the chief source of anxiety to the surgeon, especially the abdominal surgeon, but this risk has been so nearly eliminated by the perfection of operative technic that shock and pneumonia are now the chief sources of anxiety. Pneumonia and shock are much more easily prevented than cured. It is important to make sure before operation that the patient is not a pneumonia carrier by a careful examination of the secretions of the upper air passages.

It has been the writer's practice for twenty years or more, to begin treating every patient for pneumonia at the same moment that the administration of the anesthetic is begun. The great value of hydriatic applications to the chest and the hot pack to the body, in general, in the treatment of pneumonia has been well established. The value of these measures was well shown in the great epidemic of influenza of 1918 in a community adjacent to a large cantonment. Among 200 cases of influenza, many of them complicated with pneumonia, only two deaths occurred, a mortality of 1 per cent. In a series of more than 200 cases of lobar pneumonia treated by the hydriatic method, the mortality was less than 6 per cent.

As soon as the anesthetic is begun, a cold compress is applied to the chest. This is changed every five minutes during the operation. The nurse who assists the anesthetist attends to the compress and takes care to rub the chest vigorously with a dry flannel cloth each time the compress is changed. The effect of this cold compress is to prevent the stasis in the lung circulation which naturally follows from the anesthetic, as shown in the darkening of the venous blood, blueness of the lips and the cyanotic appearance of the face. Pneumonia and dangerous heart weakness are very likely to follow an operation when very pronounced cyanosis occurs.

Cold applications to the chest are wonderfully effective in preventing pulmonary stasis. This remedy is so simple and practicable that it can be employed in practically all cases and under all circumstances when an anesthetic is given.

Nitrous oxid anesthesia is much less likely to be followed by pneumonia than is ether; nevertheless, the chest compress is again important for the reason that it very considerably lessens the amount of gas required. This is due to the fact that cold applications to the chest produce a notable effect upon the respiratory movements causing much deeper respiration, and so increasing the volume of the tidal air. Actual experiment shows that the tidal air is nearly doubled under the influence of the cold chest compress applied in the manner above directed.

By cold applications to the chest, renewed every five minutes during the operation, the amount of gas required and hence the danger from the anesthetic are very greatly lessened. The reason for this may be clearly seen by a moment's consideration. The intensity of the anesthesia depends, of course, upon the amount of nitrous oxid taken up by the blood. The amount absorbed depends upon the volume of gas taken into the lungs rather than upon the percentage of the gas. For example, suppose a patient to be receiving a mixture consisting of 85 per cent. nitrous oxid and 15 per cent. oxygen. With this percentage, the cheeks remain pink and the patient goes on admirably; but if the breathing becomes shallow, the amount of gas absorbed may not be sufficient to produce as profound anesthesia as is necessary. By lessening the per cent. of oxygen and increasing the proportion of nitrous oxid to 90 or 95 per cent, more gas is taken into the lungs and profound anesthesia may be produced, but the patient is likely to become cyanotic.

But the result desired may be attained without the undesirable cyanosis and without increasing the percentage of gas and so diminishing the intake of oxygen. All that is needed is that the patient shall breathe deeper. By cold applications, the patient may be easily made to double the amount of the gas mixture inhaled, and thus increase the amount of nitrous oxid taken in without increasing the percentage; and so, while more nitrous oxid is being received and absorbed, more oxygen will be taken in and absorbed also. By this means, profound anesthesia may be induced without producing cyanosis which is always to be assiduously avoided. The use of the chest compress in the manner suggested is thus, I find, a most effective safeguard against the chief danger from nitrous oxid anesthesia.

Every possible means is employed to lessen

traumatism. The incision is no larger than necessary. This saves time as well as traumatism. The edges of the wounds are protected from bruising. Pointed instead of broad forceps are used for picking up arteries, and the arteries are tied at once instead of leaving the forceps long in place. Intestines and other parts are manipulated as little as possible. Special care is taken to avoid abrading or bruising the peritoneal surfaces. Instead of cheese cloth napkins, padded napkins covered with Chinese silk and oiled with paraffin, are used for walling off the intestines. These silk-covered napkins have the advantage that they do not adhere to the intestines and cause superficial traumatisms, as do cotton napkins, and, when drawn out of the abdomen, they do not drag the intestines after them as do ordinary napkins. By applying all these means, the danger of adhesions is greatly lessened.

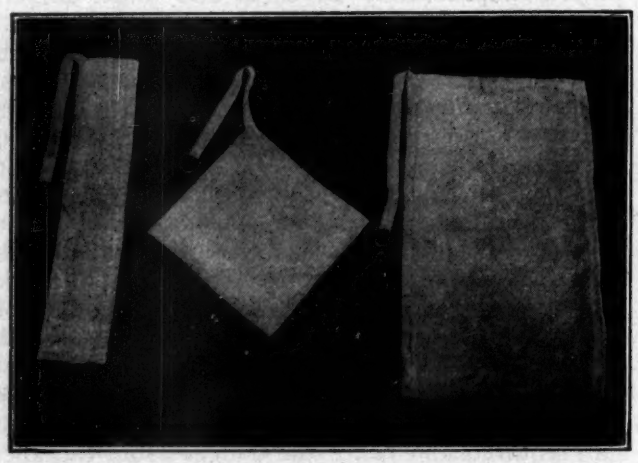

Fig. 1. Silk pads for use in laparatomies.

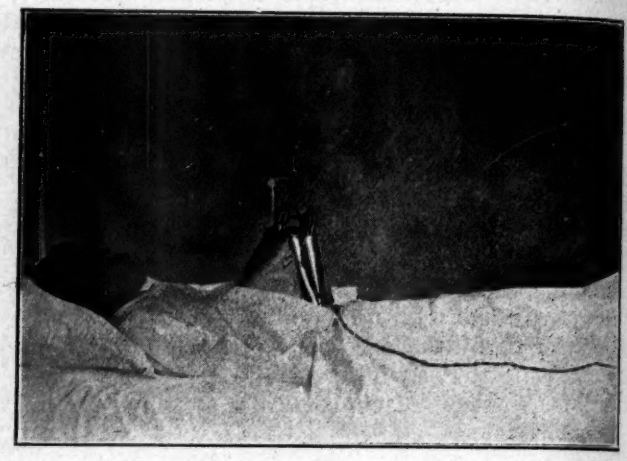

Fig. 2. Photophore.

Small catgut is used in closing the wound, and no more is introduced than is required for safety.

The Blood-Pressure During the Operation.—A measure of safety that I consider of great importance, and that I have uniformly employed for many years, is taking the patient's blood-pressure every five minutes during the operation. The pressure is taken just before the operation and the results are announced to the surgeon, and also when any marked change occurs during the operation. Each reading is recorded, as soon as taken, in large figures on a placard placed so to be easily seen by the surgeon. A trained assistant or the anesthetist holds a finger upon the pulse continually, during the entire operation. The cuff of the blood-pressure instrument is kept constantly upon the arm, being loosened after each reading of the instrument. It is important that the diastolic as well as the systolic pressure should be noted. The diastolic pressure is in fact a better indicator of the condition of the bloodvessels than the systolic.

If there is any considerable drop in the pressure, Ringer's solution is introduced by infusion or intravenously in sufficient quantity to bring the pressure back to normal. It is much easier to combat incipient shock than to deal with this condition when fully developed, hence it is important to recognize the earliest symptoms of beginning shock which can be done only by closely watching the blood pressure during the operative procedure. A considerable fall of pressure is an indication for the transfusion of blood from a suitable donor. It is well on this account to determine the classification of the blood of the patient before the operation. It is the writer's practice to keep a list of thirty or forty classified donors in readiness.

Celerity in Operation.—Another matter of importance is the time occupied with the operation. When the patient is brought to the operating room, the operation should begin at once, as the patient is in a state of suspense and tension, and hence losing energy at a rapid rate. Long waiting in a state of suspense may exhaust the patient as much as the operation itself. The normal energy expenditure through tension is 30 to 50 per cent. of the basal metabolism. This rate may be increased several times by nervousness, fear, or suspense, thus causing rapid loss of energy which in the case of a feeble patient may be a factor of grave importance.

After the operation is begun, not a moment should be wasted in doing things which could have been done before. Every moment is precious. Celerity in operation, not through undue haste, but by the aid of quick methods and manual dexterity, supported by well-trained and attentive assistants, good instruments, a good light, and the elimination of all distracting elements so that the attention and energy of the surgeon and all his assistants may be concentrated upon the work in hand, is certainly a matter of no small advantage to the patient, since it secures to him the least possible handling of the tissues, the shortest possible exposure, and the smallest possible amount of anesthetic—all considerations of great importance. I find that patients in whom the operation is completed in the shortest time, other things being equal, make the most rapid convalescence. I do not pride myself on being a rapid operator and should be ashamed to be known as a hasty operator; but I aim to reduce the time of my operations to the smallest number of minutes and seconds consistent with complete, thor-

ough, and neat work. Everything that needs to be done must be done, and must be done well; but fussiness, hesitancy, and loss of time from any avoidable cause lessen chances of prompt recovery.

A patient who is kept upon the operating table two hours or more for an abdominal operation which a manually dexterous surgeon usually completes in twenty to forty minutes has greatly increased chances of suffering from shock or collapse, pneumonia, peritonitis, adhesions and other complications and greatly lessened chances of recovery and quick convalescence. A well executed operation is best done when quickly done.

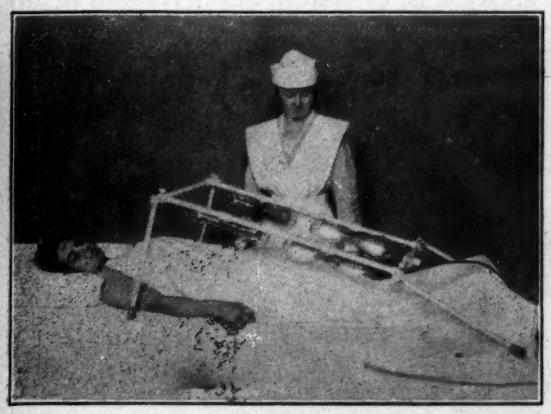

Fig. 3. Applying the Electric Lamp Radiator.

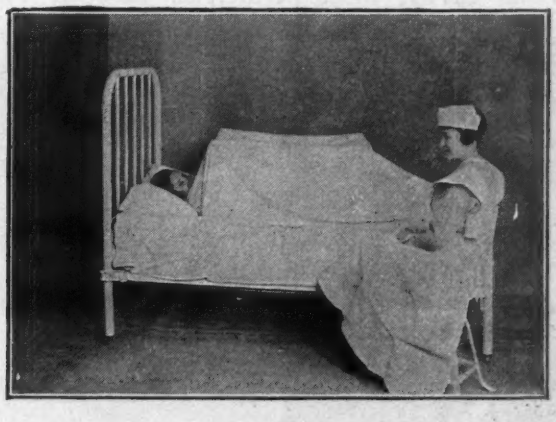

Fig. 4. Electric Lamp Radiator in Place and Covered.

The thorough rehearsal of nurses and assistants who are to take part in an operation is a most valuable aid in expediting operative work. Movies of abdominal and other operations are also freely used as a means of making operating room nurses thoroughly familiar with the technic.

POST-OPERATIVE CARE.

The post-operative care of the patient is greatly simplified by the proper pre-operative preparation. To combat shock, collapse and pain, are the immediate requirements; to prevent pneumonia, peritonitis, adhesions, wound infection and other complications are also matters of importance. Rational and physiologic means prove wonderfully effectual in meeting all these indications.

The crowning achievement of scientific medicine is prophylaxis, and there is no branch of medicine in which preventive medicine may be more successfully and more appropriately employed than in surgery. This is especially true with reference to shock.

Prevention of Shock.—The measures which I rely upon for the prevention of shock are the following:

(1) Saturation of the patient's tissues with water by copious drinking, and, if necessary, the use of retaining enemas for a few days prior to the operation and the morning of the operation.

(2) The employment of nitrous oxid and oxygen as an anesthetic instead of ether or chloroform, a practice which I have followed for the last sixteen or seventeen years, during most which time ether has been rarely used and chloroform almost never.

(3) Small wounds, delicate handling of the tissues and as great celerity as possible in operation.

(4) Careful watching of the blood pressure, systolic and diastolic, during the entire operation. Infusion of Ringer's solution if needed and transfusion when necessary.

(5) After the operation, heat is applied to the hips and legs, and the skin is vigorously rubbed with mitts or towels wrung out of cold water.

(6) In some cases, marked benefits seem to be derived from introducing into the colon two or three pints of water at a temperature of 80° F.

In case of collapse from weakness, loss of blood or from heart failure due to myocarditis or other cause, the same measures are used as for shock, and, in addition, intravenous injection of Ringer's solution or transfusion of blood. Special care is taken to avoid permitting the patient to become cyanotic. The application of cold compresses to the chest, renewed every five minutes, as already explained, is one of the most efficient means of preventing cyanosis and collapse.

As soon as the patient arrives at his room, he is placed at once in a warm pack which should extend from the feet to the hips or even to the shoulders. Hot applications may be made either with a blanket wrung out of hot water, a large fomentation applied to each leg and the back and hips separately, or the electric thermophore blanket. The last-named appliance is exceedingly convenient and has been in daily use in my wards for many years. The radiator, or other means by which the heat of incandescent lamps may be utilized, is also a good heating measure. Care should be taken to avoid over-heating. As soon as the skin is well warmed, a cold towel rub or mitten friction is applied to the entire surface of the body not covered by the dressing. Cold friction not only energizes the heart and thus raises the blood pressure but stimulates the peripheral bloodvessels, thus directly combating shock.

I have made use of these hydriatic measures for more than thirty years and with most excellent results. I am glad to note that the rationale of the effects produced is quite in harmony with the theory of shock brought forward by Cannon, and others, as the result of their studies of this condition at the front, in France. If it is true that the immediate cause of shock is paralysis of the small bloodvessels, which permits an undue accumulation of blood in

the arterioles and capillaries, as the result of the influence of toxins thrown into the circulation from the wound, it is evident that short applications to the skin of heat followed by cold rubbing, must be a most efficient means of combating this most serious of surgical complications.

Non-Drug Measures for Relief of Post-Operative Pain.—The pain following operation may, in most cases, be easily relieved by the administration of some preparation of opium, either by itself or in combination with atropia. But, unfortunately, the effects of the free use of these drugs is in a large class of cases, especially operations involving the abdominal cavity, most pernicious. Lawson Tait

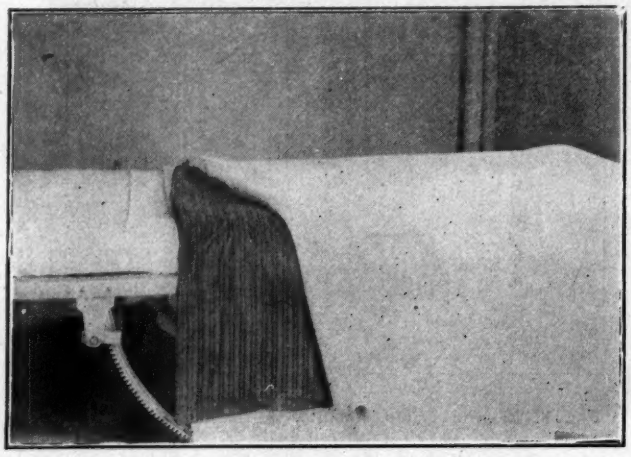

Fig. 5. Electric thermophore blanket.

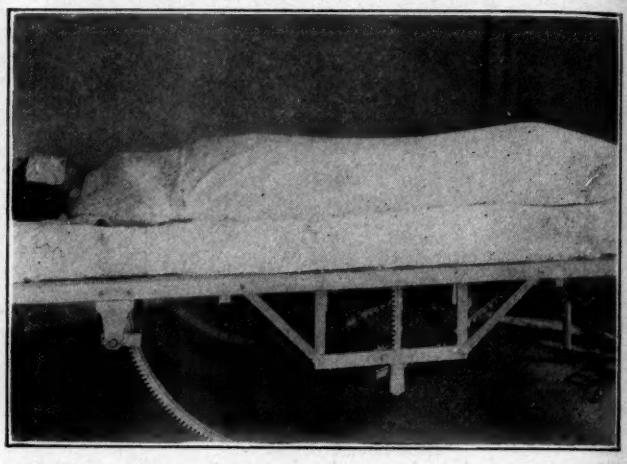

Fig. 6. Hot pack with thermophore blanket after operation to combat shock and pain.

was the first to call attention to this fact. Prior to his work, it was the universal custom to administer opium in liberal doses after abdominal operations. The bowels were often tied up for a week or more. In those days, it was customary with many surgeons to put in mattress sutures of thick silk to prevent the patient from bursting open, as the result of the enormous tympanites which sometimes developed.

Tait refused to give anodynes of any sort. He laid very great stress upon this point and believed his phenomenal success to be largely due to the avoidance of narcotic drugs. When questioned on the subject, he told me that he never gave an anodyne of any kind unless he was convinced that the patient was going to die. When I asked "What do you do when the patient suffers so greatly as to disturb other patients by groans and screams?" which one often heard in his wards, he said, "I tell the patient to shut up, that such noise is not permitted."

"But suppose the patient does not shut up. What then?" "I discharge the nurse," was Tait's reply, and that he did. The nurse was made to understand that it was her duty to keep the patient quiet, but no means were placed in her hands for accomplishing this except the rude word of command, "Shut up."

It occurred to me that the resources of hydrotherapy, such as the hot foot-bath, the hot hip and leg pack, fomentations and other measures might prove as efficient in relieving the pelvic pain following an operation as in relieving the pain of dysmenorrhea or of cystitis or colic. I had often succeeded in relieving such pains and even severe neuralgia of the face and toothache, by heat applied to the lower extremities. On trial I was delighted to find these measures wonderfully helpful when employed with surgical cases, and within a few months worked out a routine which I have followed with little variation for more than thirty years.

Of more than 12,000 patients operated upon by myself, only a small percentage have been given morphia or strong narcotics of any sort, yet they have been made so comfortable that they were able to sleep at night, and rarely asked for an anodyne. An anodyne is, of course, never refused in any case in which the patient really suffers severely and is not substantially relieved by the treatment given, but this seldom occurs. Anodynes increase the difficulty of moving the bowels early, the importance of which cannot be overestimated, especially in abdominal cases. When the effect of the anodyne is gone, the patient usually suffers more than before and often a drug habit is formed.

In a large hospital which I visited, where morphia is used as a routine after all abdominal operations during the first two days, a nurse said to me, "We have an awful fight the third night when the drug is withdrawn." An "awful fight" on account of pain is a very rare occurrence in my experience. After the first few hours the patient suffers little.

The application of heat over the wound by means of the photophore or the radiator and to the lower extremities immediately following the operation, even before the patient is fully out from under the anesthetic, prevents the development of the nervous state in which slight pains are so exaggerated, making the patient restless and irritable.

The hot blanket applied immediately after the operation not only combats shock and collapse but also relieves pain to such a degree that the patient often sleeps during the application, and usually gets several hours' sleep during the first night without the use of drugs. If anything is needed, it will be nothing more than one or two doses of 1/24 or 1/12 grain of heroin, or a single grain of codein.

Sandbags to prop the patient up on all sides so

as to relieve tension are of great service. The sand bags may be heated if the effect of heat is needed.

Keeping the bowels empty by means of warm enemas will often obviate the use of an opiate by preventing gas pains. Gas pains are greatly lessened by avoidance of the use of laxative drugs before the operation.

Adhesions After Abdominal Operations.—The use of the Chinese silk napkins greatly lessens the tendency to adhesions by preventing the abrasion of peritoneal surfaces which results from rough handling, especially in the use of the ordinary cheese cloth napkin.

Post-Operative Colon Stasis.—Colon stasis, due to a spastic condition of the descending colon or any other cause, often becomes exceedingly troublesome, and leads to disaster especially in cases of abdominal surgery. The presence of fermentable residues in the colon leads to gas formation, often with enormous distension, given rise to gas pains which greatly disturb the patient, preventing rest, and thus tending to produce exhaustion.

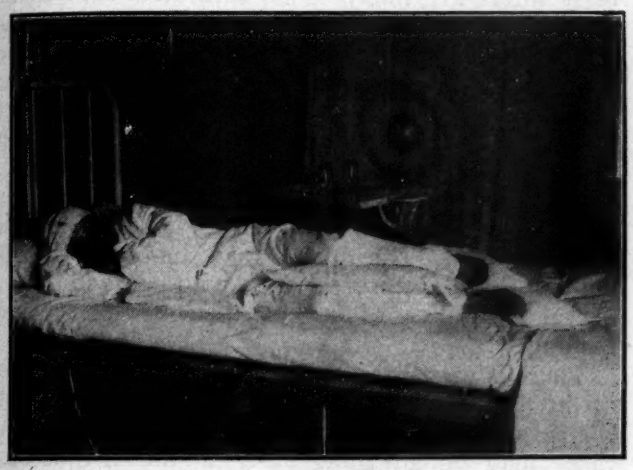

Fig. 7. Use of cushions and sand bags to relieve tension.

This condition may be combated by putting the patient under treatment for regulation of the colon activity some days or weeks in advance of the operation. Cathartics must be avoided and the colon should be evacuated with water at a temperature of 102°-105° F., one of the best means of combating the gas pains following a laparotomy.

The ordinary hospital regime, especially in abdominal cases tends to produce post-operative constipation. Before operation, the patient is purged, and his intake of food greatly reduced. He is usually instructed to avoid coarse vegetables. The day before operation, the patient takes extra oil and salts of some sort to prepare him for the operation. The effect of this is contraction of the descending and pelvic colon, a spastic condition which renders evacuation of the bowels almost impossible. Gas accumulates in the cecum and small intestines, ascending and transverse colon, and the patient suffers fully through inability to get rid of the gas. Constipation is increased by the use of morphia taken before and after the operation. The diet is usually of a constipating character, consisting of bland gruels, etc., so-called "light diet." All these bland foods are constipating unless supplemented with paraffin oil and bran, which may be taken in very moderate doses at first, and gradually increased later.

For more than twenty-five years, it has been my practice to administer within an hour or two after the operation a copious enema, two or three pints, for the purpose of promoting peristalsis. To render the enema most effective, the temperature should be 85° to 90° F. rather than higher.

My original purpose in adopting this measure was to induce the passage of a peristaltic wave the whole length of the intestine, and by this means to straighten out kinks or folds in the intestine, and to place each convolution in its own particular place. The enema also combats shock.

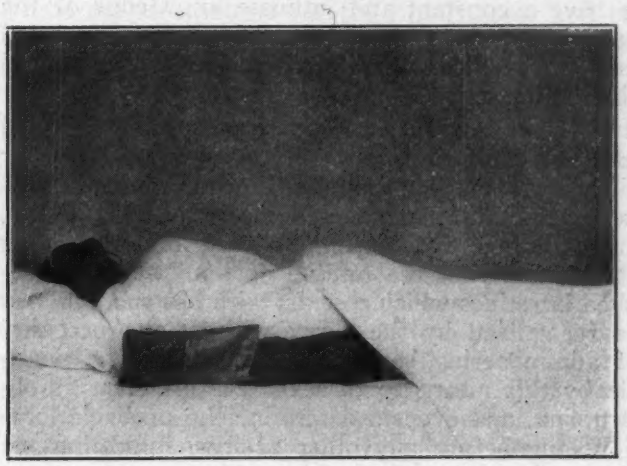

Fig. 8. Sand bags applied to back.

I endeavor to increase the efficiency of the enema by adding malt sugar or milk sugar in the proportion of about 10 per cent. Molasses or corn syrup may be used instead but is less efficient. In recent years, I have appreciated the additional advantage from the sugar solution used in this fashion from the fact that sugar is the most efficient of all means for combating acidosis, a condition which is always present after profound general anesthesia, no matter what anesthetic is employed.

It seems to me quite probable that the crippled condition of the liver and other organs associated with the intimate metabolic processes of the body, particularly the thyroid and the adrenals, may be an important factor in shock. Certainly, I have seen most excellent results from the use of the sugar water enema employed in this way, and should not be willing to dispense with it as a part of my hospital routine.

The sugar water enema (an ounce and a half to the pint) is repeated in smaller, frequent doses for several days, usually a pint every three hours, the patient being allowed to retain as much as he will.

Another beneficial effect of the sugar water is to prevent putrefaction in the colon and thus prevent the toxemia which rapidly develops when intestinal stasis occurs in a depressed or feeble patient, still further crippling the liver and kidneys which have had to perform the great task of dealing with the anesthetic.

Post-Operative Testing of the Intestinal Motility.—The first night after the operation, the patient is given a carmine capsule, and a little later, a dose of mineral oil. The purpose of these is to act as indicators of the intestinal motility. When the carmine and oil appear in quantity one knows there can be no serious obstruction. The appearance of the carmine at the end of forty-eight hours, or even later, is an almost equally good omen, though it is, of course, possible for obstructions to develop at a later period. On this account, it is necessary to apply the test again after two or three days. It is, in fact, well to repeat the carmine test at intervals of two or three days while the patient is convalescing, so as to have a constant and intimate knowledge of the behavior of the alimentary tract. It is to be noted that traces of carmine may appear when partial obstruction exists.

If the patient suffers from vomiting on the third day following the operation, and if the carmine or oil has not made its appearance in quantity, an *x*-ray examination is made. Some years ago (1915), my colleague, Dr. Case, published the interesting observation that the outline of the distended gas-filled intestines which co-exist with obstruction, may be recognized by the *x*-ray without the necessity of administering barium. It is, fortunately, possible by this means to discover the presence of obstruction, and even to determine the probable location long before any other positive indications of obstruction are obtainable. As every surgeon knows, success in the treatment of obstruction depends upon its early recognition and prompt action.

POST-OPERATIVE FEEDING.

The post-operative feeding of surgical cases is a matter which has received far less attention than its importance demands. In many cases, the patients's nutrition has been seriously interfered with for some time before the operation by the conditions which make the operation necessary. In my opinion, the starvation of patients, either before or after operation, is not only unnecessary but is highly prejudicial to the patient's interests, lessening the chance of recovery and increasing the danger of serious complications. Food is a most important regulator of metabolism. Assimilated food furnishes the material upon which the cell works, both in the performance of its functions and in the repair of its own structure. If material is not supplied in the form of food, the body must draw upon its tissues.

Food, likewise, is the only source of energy for the body. The heart alone consumes approximately two ounces of sugar every twenty-four hours in doing its work in the circulation of the blood.

Furthermore, food furnishes a physiological stimulus to the living cells. The rapid loss of strength and endurance as the result of fasting, and the marvelously rapid restoration of energy by appropriate nourishment, afford ample evidence of the helpful stimulus which may be secured through proper feeding. This stimulation is doubtless due in large measure to the presence of vitamins which abound in certain foods and in which vegetable broths are rich. These vegetable broths differ from bouillon and animal broths in the fact that, while rich in vitamins, they contain no urea and other waste matters of which animal broths are largely made up while containing vitamins in small amount only.

The eating habits of most patients lead to an accumulation of protein wastes in the tissues. Since all excess of protein must be eliminated as urea and other nitrogenous wastes, both the liver and kidneys are overtaxed by this excess protein metabolism causing a predisposition to acidosis and uremia. In addition to these waste products from excessive protein metabolism, the blood and other body fluids are likely to be saturated with toxins of bacterial origin derived from the colon. On this account it is most unwise to feed a prospective surgical patient large quantities of meats of various sorts as a means of preparing him for the operation, or to advise such a diet for promoting convalescence after operation. On the other hand, a low protein diet for a few days before the operation and immediately following the operation, is most advantageous. The blood may be more rapidly built up by a lactocereal diet, with the addition of liberal quantities of greens than by heavy meat feeding.

There is usually a sufficient amount of fats stored up in the tissues to supply the needs of the body for a few days, and the fat intake in post-operative cases may be advantageously diminished because of the inhibitory effect of the operation upon the secretion of gastric juice, which is important in gastric cases especially in preventing the putrefaction of stagnant gastric fluids and so maintaining conditions favorable to healing. It is well to remember, also, that the body is able to manufacture fat from carbohydrates and that starch and sugar are, under normal conditions, the chief sources of body fat.

Abundant carbohydrate feeding is a matter of chief interest in relation to surgical cases. Farinaceous foods of all sorts, fruit juices and malt or milk sugar are the most appropriate materials for feeding a patient on the days before operation and two to five days succeeding.

The feeding should begin early—as soon as vomiting is controlled, for several reasons: The sooner feeding can be begun, the less will be the danger of exhaustion, since the food supply, rather than the tissues of the patient, will thus be the source of energy.

Another benefit to be derived from early feeding, which is especially noticeable in operations upon the stomach and gallbladder, is the suppression of "hunger pains" which Carlson has shown to be due to violent contractions of the stomach. Bland food introduced into the stomach is often more effective than morphia or any other anodyne in controlling the pain following operations on the gallbladder or the stomach.

It is well to remember, also, that food is a natural laxative. Taking food into the stomach sets up peristaltic waves which travel over the entire intestinal tract, thus encouraging evacuation and the elimination of waste matters from the colon.

This early peristalsis has the effect to straighten out kinks in the intestine and to break up newly-formed adhesions which have not yet become organized. It is even advantageous in many cases to make use of moderate quantities of agar or gruels containing bran. By supplying stimulants in these forms, the early restoration of normal bowel action may be greatly encouraged.

I am not able to see any advantage in withholding food altogether during the first days following an operation upon the stomach. Rice gruel or malt sugar solution, sometimes even orange juice, may be taken with advantage.

I find careful early feeding is especially advantageous in cases of gastric surgery, as in gastro-jejunostomy, pylorectomy and the Polya operations, as well as in other cases.

The objection that foods may be irritating does not hold good for the reason that bland foods of the sort mentioned must be far less irritating than the acrid matters invariably present. Such foods certainly will be as well tolerated by the stomach as the stagnant, germ-infected, often foul-smelling and irritating material usually found in the stomach after operation. The effect of taking food in such cases is to dilute or wash away the stagnant fluids resulting from oozing, involuntary swallowing of the saliva, etc. Displacing the putrefying gastric contents by a small quantity of bland and sterile rice gruel, often produces a most favorable effect, relieving nausea, hunger pains and other distressing symptoms.

The fact that taking fluid into the stomach may give rise to gastric secretion cannot be regarded as an objection to early feeding for the reason that the gastric juice is the normal disinfectant of the stomach, and its presence will help to suppress putrefactive changes in the gastric fluids, and will hence promote the healing process rather than to prevent it.

When the patient does not vomit, malt sugar water containing two ounces of malt sugar to the pint or fruit juice of some sort containing the same proportion of sugar, is given in spoonful doses hourly, and affords the patient exactly the right kind of nourishment required. Pathogenic organisms do not grow in sugar water, fruit juice or gruel, while they thrive in blood serum, bouillon and broths.

Of course, it is important to avoid overfeeding. A half ounce of rice gruel every two hours while the patient is awake, the first day, increased by half an ounce on the second day, is none too much food for the average patient. After the first few days, spinach puree may be added to promote blood building and thorough evacuation of the colon.

Bouillon, beef juice, broths and similar preparations are carefully avoided, and, in fact, are never admitted to my ward. Vegetable broths, which are quite as appetizing as any of the preparations mentioned and wholly free from unwholesome properties, are freely used. A bouillon prepared from yeast extract so closely resembles bouillon, or extract of beef that it is readily accepted in place of it, and is, in fact, found more palatable, besides, this yeast extract (known commercially as "Marmite," "Savora," and by many other names) is richer in vitamins and in iron than any other food substance.

Gruel diet is relied upon only for a very short time, a few days at the most. Simple purees of vegetables and fruits are allowed after the first two or three days, and these are accompanied by agar jellies and agar in substance or special bran preparations to encourage bowel action. Purees of spinach or other greens are daily on the menu in some form. These lime and iron containing foods are essential to rapid blood building and tissue repair and help to sustain the heart in its arduous work. Green foods are also rich in the vitamins which are as essential for the rapid repair and rebuilding of the tissues as for the normal growth of young animals.

Every meal is carefully balanced not only for proteins, fats and carbohydrates, but for cellulose, food lime and iron and other salts and vitamins. The ordinary hospital diet is woefully deficient not only in lime, iron and vitamins but in cellulose, the natural laxative element of the food.

Acidosis.—Metabolism tests for acidosis, through determination of the CO_2 tension of the residual air of the lungs are always made before operation and daily for several days following the operation and until the metabolism becomes normal. These tests are of value in all cases, and are indispensable in operating upon persons suffering from diabetes.

The reduction of protein and fats to a low level just before and immediately following the operation, while supplying carbohydrates in abundance, is a very efficient means of greatly reducing the dangers of acidosis.

Free feeding of carbohydrates following the operation causes a speedy disappearance of acidosis, as shown by the rapid rise of the CO_2 tension of the residual air.

For Nausea and Vomiting.—Nausea and vomiting increase the tendency to acidosis by interfering with the patient's nutrition, and hence are decidedly more than an inconvenience. After ether anesthesia, washing the stomach out removes the poisons which accumulate in the stomach. The application of the moist girdle, with a hot bag over the stomach, is a very effective means of controlling post-operative nausea and vomiting. This simple but effective measure acts by lowering the tonus of the gastric musculature and thus checking the violent gastric contractions to which Carlson has shown nausea to be in most cases due. Other well-known measures are of course employed when indicated. Turning the patient on the left side often prevents nausea and vomiting by relieving the strain upon the cardiac orifice.

TO INCREASE VITAL RESISTANCE FOLLOWING OPERATION.

The warm packs followed by cold rubbing wonderfully increases the patient's resistance, while at the same time relieving pain, nervousness and other discomforts.

A repetition of the applications two or three times a day serves to double the number of leucocytes in the circulation of the blood, and thus in-

creases the patient's defensive power and his ability to cope with pathogenic bacteria, combats infection, and encourages repair of the operation wound.

These applications are given not only immediately following the operation, but daily until convalescence is well established.

Wound Infection.—Infection of wounds may be due to low resistance on the part of the tissues as well as to the introduction of pus-forming germs. As a matter of fact, it is practically impossible to prevent more or less contamination of surgical wounds by air germs, some of which are capable of producing serious disease; hence the resistance of the patient's tissues is after all the dominating factor in the prevention of wound sepsis.

It is often vitally important that the tissues should be re-enforced by the application of heat to the wound. The arc light is, perhaps, the most efficient method for accomplishing this. The incandescent lamp and other sources of heat are also found beneficial.

The time required for the patient to recover from a severe surgical operation depends very largely upon the precautions taken to prevent shock, collapse and other complications tending to lower the patient's vitality and to develop complications. When the general program suggested is faithfully carried out, convalescence is usually rapid. After severe operations, my patients are often sitting up within forty-eight hours. On the third or fourth day they are permitted to take an airing in a wheelchair, and a few days later are permitted to get upon their feet, care being taken, of course, to prevent strain or violent exertion.

THE POST-OPERATIVE WATER RATION.

An abundant supply of water is essential after every serious operation to carry off the shock toxins, replace lost fluids and to promote heart action. A half pint of water every hour is the usual program; by mouth if there is no vomiting, by both mouth and rectum if there is nausea and vomiting. The quantity of urine is the best check upon the faithfulness and efficiency of the nurse in getting the patient to take and retain the three or four quarts of water daily required.

FRESH-AIR SLEEPING.

As soon as possible after operation the patient is given the benefit of fresh air day and night. Large open and glass enclosed porches connected with the wards on each floor afford opportunity for airing in all seasons and all weathers. Within two or at most three days after the operation the patient is gotten out into the fresh air and spends as little time as possible in his room. At night, outside windows are opened wide, the patient being carefully protected from chilling draughts.

The invigorating effects of these airings is most marked. Sleep, appetite, healing and convalescence are all greatly encouraged.

Sunbaths are secured whenever possible.

The arc light is made use of as an invigorating measure in appropriate cases and greatly enhances the healing process.

EXERCISE FOR SURGICAL PATIENTS.

Very likely the idea of exercise for surgical cases will at first blush appear quite impractical and inappropriate. So I hasten to explain that by exercise is not meant a morning walk or a visit to the gymnasium, but such simple "bed exercises" as deep breathing, and flexing of the fingers and toes. These begin on the second day. Even the first day the patient is encouraged to take a few deep breaths every hour to combat pulmonary stasis and to encourage the splanchnic circulation. These breathing movements aid the absorption of liquids from the intestine and the movement of the food residues along the colon. They also tend to combat hypostatic pneumonia and bronchitis.

From day to day the exercises are increased so as finally to include arm and leg flexing, arms raising, legs raising, turning in bed, and a considerable variety of movements of the extremities.

The purpose of these exercises is to combat the ill effects of bed confinement, the weakening of the heart, loss of vascular tonus, weakness of the muscles, increase of intestinal stasis and general loss of bodily muscular power and control which inevitably result from a long idleness in bed.

An elevation of temperature, pain on movement, and various other special conditions may of course contraindicate exercise of any sort, and demand absolute rest; but most surgical patients, even abdominal cases, are greatly benefited by exercise of the muscles judiciously administered, and especially by deep breathing exercises. The benefits are shown in early convalescence, a sense of strength and security which enables the patient to rise from his bed in about half the usual time required in bed and to find himself steady on his feet on rising from his bed, even after several weeks' confinement.

When the patient is necessarily confined to bed for a long time, automatic exercises are administered when possible so as to prevent the inevitable degeneracy which results from long confinement. This is given by a special device which brings into action all the larger groups of muscles of the body by electrical stimulation and without any effort by the patient. The muscles are weighted and thus made to do more or less work as indicated in the individual case.

It will be evident from the foregoing that a surgeon who undertakes to avoid opiates as much as possible in the post-operative care of his patients and to surround them with every measure of comfort and safety must require of his nurses a much broader knowledge, more training in physiotherapy and reconstructive measures, and a much higher degree of efficiency than the ordinary surgical nurse possesses. Unfortunately, the ordinary hospital course of training does not at the present time give the amount of time and attention to physiologic measures of treatment necessary to afford a nurse the practical training essential to proficiency in the dietetic and hydriatic management of patients. It is to be hoped that a change in this regard may take place within the next few years. Certainly such a change would greatly contribute to the comfort of surgical patients and to the lowering of the death rate in surgical practice.

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WALTER M. BRICKNER, M.D., F.A.C.S., Editor.

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PRE- AND POST-OPERATIVE MANAGEMENT.

In the successful conduct of a surgical case the preparation for, and, especially, the treatment after, operation are of importance ranking close to that of the operation itself. Surgeons visiting from one hospital to another are, or should be, interested as much in the methods pursued during the post-operative period as in the operations. There is as much for such visitors to observe in the wards as in the surgical amphitheater. Although pre- and post-operative methods tend to a standardization, to a routine, in each institution, they probably vary more from one hospital to another, than do the methods in the operating room.

In the past fifteen or twenty years preparation for operation and routine after-treatment have undergone much simplification. It might be said that that patient is best treated after operation who is treated least. This does not mean, of course, neglect of the patient; it does mean avoidance of the infliction upon him of those bowel-tormenting and other measures which we used to think essential to his recovery.

No longer are patients submitted to much fasting and vigorous purgation before operation. We have learned that these are both bad. Eating and, especially, drinking may be and, indeed, should be continued, in most cases, up to within a few hours of the operation. A simple enema is usually sufficient preparation of the bowels or, at most, a mild laxative also. It is usually only in cases of operation upon the lower bowel or upon individuals who have been greatly constipated that purging before operation is indicated.

The one-time preparatory vigorous scrubbing of the "field of operation," the preliminary application thereto of an uncomfortable and often irritating antiseptic dressing, and the time-consuming re-scrubbing and disinfecting of the skin on the operating table, have all been replaced, in the work of progressive surgeons, by simple shaving and cleansing of the skin before the operation and the application thereto, on the table, of 3½% tincture of iodine or of 5% alcoholic solution of picric acid—preferably after drying the surface with benzine, ether or both.

No longer do most surgeons soon after a laparotomy bombard the patients bowels with calomel, salts and other purgatives; and eserine, which some few years ago held for a time a prominent place as a means of preventing post-operative distention, has gone into the discard because its administration is usually as unnecessary as it is painful. If the intestines are not irritated by purgation before, or undue handling during, operation they usually give but little trouble afterwards. When one is in bed and on scant diet, his bowels may be allowed to go unevacuated for three or more days after an operation; and usually the resumption of these evacuations can be inaugurated with least distress by an enema. A satisfactory routine after a laparatomy (e. g. cholecystectomy, appendicectomy, hernioplasty) is to give fluid diet for two days following that of the operation, administer an enema the morning of the third day and give "light diet" after the bowels are thus moved; thereafter enemata or laxatives are ordered only as needed.

To be sure, the simplified pre- and post-operative routine is only a routine. There are many cases in which, because of the nature of the operation to be performed or a toxic or debilitated state of the patient, much more active preparation should be undertaken, if time permits. In the after-treatment, too, just as the bowels should need little interference in most cases, so, by contrast, there are other cases where moderate gas distention or actual intestinal paralysis call insistently for very active treatment to relieve great distress or even to save life.

Special types of operation, too,—cerebral, thoracic, gastric, intestinal, rectal, vesical, vaginal—require modifications of the after-treatment. It is the comparative study of the routines adopted for

these special operations, of the methods of treating or preventing various post-operative complications, that is interesting to the visitor from one hospital to another.

The methods evolved for the preparation for, and treatment after, operation at the Battle Creek Sanitarium are, by comparison with those at many other institutions, quite elaborate.

In presenting them in detail in this issue we are, so to speak, bringing this clinic to those of our readers who have not visited it. They will find of great interest, especially, the dietetic and hydrotherapeutic measures that have been evolved by Dr. Kellogg and his collaborators. They represent a set of efforts to put each patient into optimum condition for operation, and to minimize his hazard after operation. If much of this routine may appear unnecessary for the average, "healthy" patient, at least it will suggest to the thoughtful surgeon a great deal that will be helpful in the management, before, during or after operation of other patients.

That surgeon must be self-satisfied, indeed, who cannot find some useful procedure in the after-care methods of others! To seek such improvement in his own procedures as will increase the safety and the comfort, and accelerate the complete restoration, of his patient after operation, should be the constant aim of the surgeon. While after-care is not as often discussed as the pathology or mechanical treatment of surgical diseases, the subject is by no means neglected in our literature. In addition to current articles, like that of Kellogg in this issue of the JOURNAL, one may find a great deal of useful information in such manuals as that of Crandon and Ehrenfried on "Surgical After-Treatment" (W. B. Saunders Co.), or the recently published two-volume work of Willard Bartlett.*

*The After-Treatment of Surgical Patients. By WILLARD BARTLETT, A.M., M.D., F.A.C.S., and Collaborators. In two octavo volumes; 1,040 pages; 221 illustrations and one colored plate. St. Louis: C. V. MOSBY COMPANY, 1920.

HOSPITAL SERVICE IN EMERGENCY.

At noon on Thursday, September 16th, there was exploded in the very heart of New York City's financial district a bomb that killed thirty-five people and injured—many of them very seriously—more than two hundred more. Before the smoke had cleared, the medical superintendent and internes from a nearby, small hospital, were administering first aid on the spot; and within a very short time most of the injured had been removed to this hospital by its three ambulances and by passing trucks and taxicabs. On the floor of its dispensary department 175 or more injured—and dying—men and women were treated, and about forty were admitted into the wards and rooms of this small Broad Street Hospital, already almost filled. Everyone of these people, whether the injury was slight or grave, received promptly a prophylactic dose of tetanus antitoxin, and, where needed, a hypodermatic injection of morphine. Hot drinks were administered. Several cases of shock were promptly handled; hemorrhages were controlled; first aid dressings and splints applied; emergency amputations performed; and within the next few hours all of the wounds, many leading to bad compound fractures, were thoroughly débrided, and started on Carrel-Dakin treatment and traction splinting.

That so much was accomplished so well and so promptly in a small hospital was due to the helping hands loaned by other hospitals, to the aid furnished—in material and in nurses—by the American Red Cross, to the fact that most of the resident staff, some of the attending surgeons, the supervising nurse and some of her assistants, were familiar with the handling and surgical treatment of large numbers of wounded through recent service overseas, and, finally, to the fact that this hospital had kept itself "on its toes" for just such emergencies. It had been treating accident cases every day for the three years of its existence and it was kept well supplied with the splints, Balkan frames, etc., that such serious injuries require.

The incident teaches an important lesson. This disaster happened where the two nearest hospitals, although both small ones, are equipped for the immediate treatment of severe traumata.

It might have happened, indeed large-scale accidents do happen, at places where the nearest hospitals are not so equipped. How many of our large semi-private hospitals have on hand as many as two dozen Thomas leg and arm splints for the prompt first-aid treatment of that many fractures? How many private ambulances, attached to hospitals and otherwise, any of which might be commandeered for service in emergency, are equipped with Thomas and other splints and with a generous supply of dressings?

The questions are pertinent. It would be worth while—indeed, it is a public duty—for every hospital, in every community, whatever its purpose, to equip itself with an emergency supply of those splints, dressings and medicaments that would be required if an accident in the neighborhood should bring several injured to its doors!